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AUTONOMIC AND INTELLECTUAL FUNCTIONING

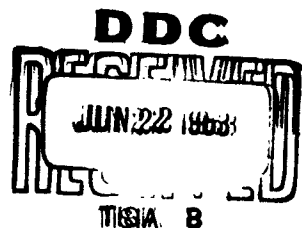
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The Effect of Natural and Induced Affect on  
Autonomic and Intellectual Functioning<sup>1</sup>

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In the theoretical and research literature of modern psychology, the term affect has been frequently employed as a synonym for emotion or feeling. However, recent theories have attempted to distinguish between affect and emotion and to conceptualize affect as a dimension of experience which may vary independently of emotion. Adherents to this approach conceive of affect experientially in terms of pleasantness and unpleasantness and behaviorally in terms of approach and avoidance (Arnold, 1960).

Murphy (1956) dichotomizes affect into a positive element and a negative element. He considers positive affect as the subjective experience of approach behavior and negative affect as the experience accompanying avoidance behavior. Positive affect, according to Murphy, is experienced as pleasant feeling and generally facilitates approach behavior, whereas negative affect is unpleasant and inhibits approach behavior. In a study designed to investigate the facilitating and inhibiting effects of affect on intellectual functioning, Wehmer and Izard (1962) defined positive and negative affect operationally as a result of friendly and unfriendly treatment. The group receiving the positive treatment performed significantly better on each of four intellectual tasks than did the group receiving the negative treatment.

Several studies have been done to investigate the relationship between autonomic functioning (level of activation) and affect as externally observed. Most of these studies have made use of psychotherapeutic interviews. Based on data from one interview with a schizophrenic patient, DiMascio, Boyd, Greenblatt, and Solomon (1955) reported that positive affect as defined by the Bales system was associated with higher heart rate. In another study, Coleman, Greenblatt, and Solomon (1956) found increased heart rate associated with overt signs of anxiety. In a case study, Mittleman and Wolff (1942) found skin temperature decrease associated with tension, increase with relaxation. In a study of 43 therapy interviews with a single therapy patient, Dittes (1957) found therapist friendliness and permissiveness negatively correlated with GSR rate. While these data from the psychotherapy situation are not entirely consistent, the weight of the evidence supports the notion that increase and decrease in activation is associated with increase and decrease in anxiety (tension), respectively.

A different approach was used by Berlin (1960). He had sorority sisters complete two forms of the Relationship Inventory, one describing a "positive" relationship and one describing a "negative" relationship. From the results, it was determined that significantly different samples of "positive" (high preference) and "negative" (low preference) relationships had been obtained. The Ss were paired accordingly and were seen in pairs during the experiment. They were told to engage in the sort of conversation that would enable two people to get to know each other better. During the experiment, records of each S's

heart rate, skin temperature, and galvanic skin response were made. Berlin viewed these autonomic variables as indices of threat. Analyses of the data revealed that high preference pairs had higher heart rates than did the low preference pairs during the interpersonal interaction. He found a decline in skin temperature for the positive relationship pairs while the negative pairs showed a rise in temperature during the experiment. Also, galvanic skin response demonstrated greater departure from resting level for the high preference pairs than for the low preference pairs. These results were interpreted to mean that greater threat (increased autonomic activity) was experienced in positive relationship (high preference) pairs than in negative (low preference) pairs. Berlin resolved the paradox of finding greater threat for the positive relationship pairs by suggesting that the high preference pairs were able to discuss more personal material of a threatening nature than were the low preference pairs.

The purpose of our study was to investigate the effects of natural and induced affect on autonomic and intellectual functioning. Natural affect refers to the affective tone of an interpersonal relationship that exists au naturel between two people. Within such relationships there may be expressions of either unfavorable attitudes and avoidance behavior (negative affect) or favorable attitudes and approach behavior (positive affect). It was assumed that the relationships characterized by positive affect would be reflected sociometrically as a mutual high preference pair, whereas relationships characterized by negative affect would be reflected sociometrically as a mutual low preference pair.

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Induced affect was assumed to be a consequence of the positive and negative interpersonal treatment administered by the E.

Only significant main effects were predicted. Thus, it was expected that high and low preference pairings and positive and negative treatment would produce significantly different effects upon autonomic and intellectual functioning.

More specifically, we wanted to see if we could show a consistent relationship between the operationally defined construct of interpersonal positive affect, autonomic activity, and effective functioning (intellectual productivity). The theorizing of Izard (1959, 1960), Murphy (1956), and Fiske and Maddi (1961) would lead us to expect:

1. Pleasant interpersonal experience → mild increase in autonomic functioning or arousal (experienced as positive affect) → facilitation of constructive behavior.
2. Unpleasant interpersonal experience → strong increase in autonomic functioning (experienced as negative affect) → inhibition of constructive behavior.

### Method

#### Subjects

Ss were selected from social fraternities at Vanderbilt University. Each S completed a form on which he listed the three people in his pledge class with whom he was most likely to become a close personal friend and the three people in his pledge class with whom he was

least likely to become a close personal friend. Ss also were asked to make the same ratings using the male students in the freshman class. They were then paired into either high mutual preference pairs or low mutual preference pairs on the basis of these sociometric data. No individual was in more than one pairing. There were 8 high preference pairs and 8 low preference pairs;  $N = 32$ .

### Design

The study design followed the  $2 \times 2$  factorial model. The two independent variables were mutual sociometric choice and interpersonal treatment. The first was the basis for constituting high and low preference pairs; the second was the basis for inferring induced positive and negative affect.

There were two types of dependent variables: (1) four autonomic measures and (2) four intellectual tests. The autonomic measures were: heart rate, heart rate variability, skin temperature, and rate of sweating. The intellectual tests were: problems of ingenuity, multiple uses, digit span reversed, and letter association. The first three of these have been described by Wehmer and Izard (1962). Letter association requires the S to name as many words as he can beginning with a given letter in one minute.

### Procedure

Ss were seen in pairs. They were seated facing each other in a sound treated room. The electrodes for the electrocardiogram recordings, the thermistors for the skin temperature, and the filter paper

for determining rate of sweating were attached to each S. Ss were instructed to sit quietly and relax. At this time, the first of the signal markings, which were used to divide the heart rate and skin temperature records into periods which correspond to the experimental transactions, was made on the kymograph paper. From this point forward, all communication was by means of a two-way intercommunication system. At the end of a 10-minute period, the E read a statement setting forth a rationale for the experiment. At the end of this, he re-entered the experimental room, removed the filter paper and replaced it with a fresh section, and then left the room.

At this time, the treatment conditions, which lasted about 40 minutes, were begun. Upon entering Vanderbilt University all Ss took a personality inventory. They were reminded of this inventory and told that the results would be read to them during the experimental session. Qualifying remarks were made that suggested either a "good" (description of a stable, mature, well-balanced personality) or a "bad" (revelations concerning phantasy life and sexual adjustment) report would be given. The intellectual tests were then announced and it was stated that they served as an accurate index of intellectual capacity and adaptability. After this, the tests were begun and Ss receiving positive treatment were given norms that were somewhat below what they might be expected to do. When necessary, Ss were told that they had achieved a higher performance score than was actually the case. They also were praised from time to time for their good work on the tests. Ss who received negative treatment were given fictitious norms that were higher than



what they might be expected to do. If necessary, these Ss were told that their performance score was lower than it actually was. Not only were these Ss told of their poor performance, but examples from their own responses were used to illustrate wrong or unacceptable answers.

The tests were always presented in the following order: problems of ingenuity, multiple uses, digit span reversed, and letter association. The test taking order within a pair of Ss was counterbalanced in an AB BA AB BA manner. After the tests were completed, 75 per cent of the Ss were told that no time remained for reading their psychological reports. It was announced that another appointment would be made for this purpose. This was done to maintain the "legitimate nature" of the report.

A report was read to the remaining Ss that was a reasonable facsimile of their more superficial personality traits and at the same time was benign enough so as not to precipitate anxiety. We thought that reading reports to a randomly selected group would reduce the effect of leakage and thereby preserve the effectiveness of the experimental treatment.

The autonomic data was converted to Lacey's (1956) Autonomic Liability Scores. This score corrects for the relationship that exists between the level of autonomic activity during rest and the level of autonomic activity during stress. The data were transformed into logarithms for this computation. Each S had three Autonomic Liability Scores, one for each autonomic function measured.

### Results

Inasmuch as there are two classes of dependent variables involved in this study, autonomic variables and performance on intellectual tests, the results are presented separately in the interest of simplicity and clarity.

#### Autonomic Measures--Pre-treatment

Autonomic measures were made for approximately ten minutes immediately prior to beginning the treatment conditions. These data, which were subjected to logarithmic transformation, were analyzed by a  $2 \times 2$  analysis of variance in order to test the hypothesis that no significant pre-treatment differences existed between the Ss that had been assigned to the preference and treatment subgroups. Of the four autonomic indices, only skin temperature showed a difference among groups. Ss who were to receive positive treatment had higher skin temperature (94.54) than did Ss who were to receive negative treatment (90.76). (When analyses were run on transformed data, the raw score means are reported in the text.)

#### Autonomic Measures--During Experimental Session

Of the four analyses for autonomic data, only that for skin temperature showed a significant difference among groups. Inspection of the means revealed that the low preference pairs' Autonomic Lability Score was higher than that of the high preference pairs.

The above analyses were based on data taken from the four periods during which a S was actually taking a test. The mean for these four periods was computed for each S and, in the case of the Autonomic

Lability Scores, this value was used as the index of autonomic functioning during the treatment period. However, for heart rate and skin temperature the raw data were in such a form as to make it possible to relate the experimental transactions to these autonomic functions. In particular, it was possible to examine the effects of time (trend over periods of the experiment) and order of taking the intellectual tests. The results of the analysis for the heart rate data appears in Table 1.

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Insert Table 1 about here  
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Of the four main effects for heart rate, only trend is significant. This is a reflection of the increase in heart rate during the experimental period. The mean heart rates from the first to the last periods are 88.45, 86.94, 94.82, and 91.66.

The interaction effect of order and trend reflects the increase in heart rate, during the experiment, of those Ss who took the tests first in relationship to the heart rate of those Ss who took the tests later. During the first two tests, Ss who took the tests first had the lower heart rate (86.62 and 86.48 as opposed to 90.32 and 87.40). The difference in heart rate for the two groups was minimal during the administration of the digits reversed test (94.54 and 95.13). During the administration of the final test, letter association, heart rate for the Ss taking the test first had risen to the point of being higher (95.43) than the heart rate (88.04) of the Ss who took the test last.

Examination of the analysis of skin temperature data in Table 2

reveals that both preference and trend are significant main effects. High preference pairs had lower skin temperature (90.20) than the low preference pairs (93.09). The significant trend effect is a reflection of the decline in skin temperature during the experiment.

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Insert Table 2 about here  
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The interaction effect upon skin temperature by treatment and trend is a consequence of the higher skin temperature that is associated with positive treatment. Examination of the means (positive treatment: 93.47, 92.38, 92.53, 91.87; negative treatment: 90.49, 90.70, 91.03, 90.63) indicated that interpretation of this effect will have to take into account the higher pre-treatment mean of those who had been assigned to the positive treatment subgroup.

Order and trend also interact significantly in producing differences in skin temperature. This effect is due to higher skin temperature for the Ss who took the tests first. The discrepancy, which is greatest during the administration of the first two tests, tends to disappear during the latter two periods of the experiment. The means for the Ss when they took the tests first are 93.39, 92.92, 92.13, and 91.71. For the Ss when they took the tests last, the means are 90.57, 90.18, 91.43, and 90.80.

A second-order interaction involving preference, treatment, and order was found to be significant. This interaction appears in Figure 1. The effect resulted, in part, from the fact that negative treatment had a different effect on high and low preference pairs.

High preference pairs who received negative treatment evidenced dramatic declines in skin temperature when they took the tests last. The low preference pairs that received negative treatment demonstrated a rise in skin temperature when they took the tests last. Positive treatment had little effect on the high preference pairs but it resulted in some decline in skin temperature for the low preference pairs.

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Insert Figure 1 about here  
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Preference, order, and trend also had a significant interaction effect upon skin temperature. Figure 2 presents this interaction. Low preference pairs demonstrated relatively stable temperature and were seemingly not affected by order or trend effects. However, high preference pairs who took the tests first showed a steady decline in skin temperature during the experiment. When these same Ss took the tests last, their skin temperature was consistently lower than at any time when they were administered the tests first.

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Insert Figure 2 about here  
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The trend effect which was found when the data from entire periods were analyzed suggested the possibility of differential autonomic functioning within each period. In order to investigate this, data for both heart rate and skin temperature were taken from the first and last thirty seconds of each period. These data were treated separately in the same manner as were those which reflected autonomic activity

during the entire periods (Tables 1 and 2). Thus, four additional trend analyses were done.

Results of these analyses for the heart rate data showed that trend was the only main effect found to be significant. Data from the first half of each of the periods indicated that heart rate was highest during the administration of the first test (97.95). It dropped abruptly (93.26) during the second test, and increased during both the third (93.95) and fourth tests (94.91). The data from the last thirty seconds of each period reveals that heart rate was low during the first two periods (86.34 and 85.88), but increased markedly during the third test (96.49), then decreased during the fourth test (89.54).

Order and trend had a significant interaction effect on heart rate during the first and last thirty seconds of each period. Those Ss who took the tests first had a higher heart rate during the first of each period, the difference being the greatest during the fourth test and the smallest during the third test (98.83, 94.17, 94.01, 99.17 for the Ss taking the tests first, and 97.07, 92.36, 93.88, 90.82 for the Ss taking the tests last). During the last part of each period, Ss who took the first and third tests last had higher heart rates (87.44 and 98.08 as opposed to 85.27 and 94.91 for the Ss who took the tests first), whereas the Ss who took tests 2 and 4 first had the higher heart rates (86.16 and 93.02 as opposed to 85.60 and 86.16 for the Ss taking the tests last). The difference was greatest during the fourth test, as was found to be the case when the data from the first thirty seconds of each period was considered.

In the comparable analyses of skin temperature data, preference was found to have a significant effect upon skin temperature during both the first and last parts of each period. High preference pairs had lower skin temperature (90.41) than the low preference pairs (93.39). The corresponding means for the last thirty seconds was 89.97 and 92.94. The treatment effect, which was significant when only the first thirty seconds of each period were considered, had disappeared by the end of the period. This effect during the first half of the periods reflects a higher skin temperature in the group of Ss who received positive treatment (92.94) than for those Ss who received negative treatment (90.86). Trend, which is significant during the first of each period, had disappeared at the end of the periods. At the first of each period, there was a tendency for the Ss' skin temperature to decrease from the first to the last period of test administration (92.81, 91.71, 91.81, 91.24).

#### Intellectual Measures

Scores on the tests that were used to reflect intellectual productivity represent the cumulative total of correct responses to the items within each test. These data were subjected to a  $2 \times 2 \times 2$  analysis of variance.

Table 3 shows that treatment had a significant effect upon performance on the problems of ingenuity test. The Ss who received positive treatment achieved a mean score of 13.31 on the entire test. Ss receiving negative treatment had a mean score of 16.44.

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Insert Table 3 about here  
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Preference and treatment had a significant interaction effect upon performance on problems of ingenuity. The high preference pairs who received positive treatment did not do as well as those high preference Ss who received negative treatment. The treatment conditions had no differential effect on the performance of the low preference Ss.

As shown in Table 4, performance on the multiple uses test was found to be significantly related to treatment. Ss receiving positive treatment achieved a mean score of 19.87. Ss who received negative treatment had a mean score of 23.94.

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Insert Table 4 about here  
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Comparable analyses for digits reversed and letter association showed no significant differences.

#### Discussion

In no case did we succeed in showing the expected relationship between all three constructs in our paradigm: pleasant interpersonal experience → positive affect (mild arousal) → increased intellectual output. In one case we found a relationship between "unpleasant" interpersonal experience (negative treatment), increased arousal, and increased intellectual functioning. This was the case for high preference Ss under negative treatment. With hindsight, we might interpret this to mean that these Ss experienced the greatest



ego-involvement in the experiment and in the intellectual tasks.

Positive treatment had no particular effects on autonomic functioning or intellectual productivity for the high preference Ss. This might be explained as reflecting the fact that these Ss were being praised for their performance and, in terms of their perception of the situation, there was no need for them to attempt to improve on the level of work that they were doing. Positive treatment might also have had the effect of reinforcing errors for these Ss. In any event, the failure of the high preference Ss to respond to positive treatment with high intellectual productivity and altered autonomic functioning is clearly not in keeping with our advance speculations regarding the effects of positive treatment. The different result for intellectual functioning obtained by Wehmer and Izard (1962) may be due largely to the fact that their treatment was aimed toward a single individual rather than a dyad.

Low preference Ss who received negative treatment were found to have higher skin temperature when they took the tests first. Also, their skin temperature was relatively stable during the course of the experiment. Their performance level on the problems of ingenuity was no different from that of low preference Ss under positive treatment. This may mean that these Ss were relieved after having seen their partners perform poorly. It is possible that these Ss had no interest in making favorable impressions on each other. Hence, a poor performance by their partners required that they do no more than equal what their partners achieved.

In low preference pairs, positive treatment was associated with a

lower skin temperature for Ss who took the tests last as compared to those who took the tests first. In this case, the S who took the test first had been praised for his performance, making it necessary for the other S, who was to take the test last, to perform equally well in order that he would also be praised.

That all the above effects were most pronounced at the beginning of the experiment and disappeared quickly thereafter could reflect an increasing state of general stress which overshadowed the effects of what may have been rather weak preference and treatment conditions. This position is supported, to a degree, by the finding that heart rate increased and skin temperature decreased during the experiment. Too, the nature of the tests might have been related to this phenomenon. The first two tests required a more abstract type of functioning, whereas the last two were more concrete measures of memory and information.

There is some question as to just how negative our low preference relationships were. Seven of the low preference pairs were composed of pledge brothers. This was necessitated by the fact that only one mutual low preference pairing could be made that involved pledges from two different fraternities. Perhaps the low preference pairs were not negative at all but simply less positive than the high preference pairs, i.e., low preference in this study very probably does not imply an active dislike between these pairs of Ss.

Berlin (1960) interpreted his results to mean that the high preference pairs in his experiment experienced higher levels of threat than did the low preference pairs. Lower skin temperature was one of

the indices seen as reflecting increased stress. We also found that high preference Ss had lower skin temperature than the low preference Ss. We prefer to interpret this as reflecting a higher degree of personal involvement for the high preference Ss. Perhaps there is no difference between this and Berlin's interpretation. There are three factors that are different in the two studies that may account, in part, for Berlin's finding significant variations in heart rate activity and an interaction effect of preference and trend upon skin temperature, which were not found in the present study. The most obvious difference is his use of females as Ss, whereas the present study used male Ss. Secondly, the nature of the tasks was quite different in the two studies. Thirdly, Berlin paired his Ss on the basis of the results obtained from the Relationship Inventory. This instrument may have provided a better or different index of interpersonal relationships than did our sociometric data.

While our study failed to give consistent support to all the expectations implicit in our general hypothesis, certain observations seem warranted.

1. For high preference pairs, our negative treatment effected a mild increase in one autonomic function and a concomitant increase in intellectual output. In terms of our hypothesized paradigm, our negative treatment was sometimes experienced as mild arousal (positive affect), and it produced the effect on intellectual functioning we expected from positive affect. Izard (1959, 1960) has suggested that positive affect as a personality sub-system involves self-involving

as they related to partner and tasks interest, responsibility, and esteem. Perhaps these feelings/characterized the high preference pairs under the negative condition.

2. It is more difficult to alter autonomic and intellectual activity with positive treatment than it is with negative treatment. Positive treatment is probably generally expected in the psychological laboratory, making it less likely that the E can do anything plausible that would have a "positive" effect over and beyond what is expected.

3. The treatment of Ss in pairs as opposed to treatment of Ss individually apparently produces different or additional effects.

4. What may be considered ordinary aspects of experimental procedure (e.g., order of testing, time) may appear as treatment effects in autonomic functioning. This finding may help explain some of the inconsistencies in the literature.

5. In a paper published after completion of our study, Shagass (1963) sounds a note of caution regarding the fact that each physiological function has unique time characteristics, e.g., latency, duration, recovery. To this observation we can add our finding that while heart rate was increasing, skin temperature was decreasing, and sweat rate showed no discernible change.

6. Our results point to the need for increased sophistication and precision in studies involving the recording of autonomic activities. Interpersonal interactions are highly complex at the physiological level, too!

7. A more definitive test of our hypothesized paradigm relating interpersonal experience, positive affect (physiologically indicated),

and effective behavior will await: (a) better definition of positive affect at the interpersonal and physiological level; (b) better ways of assuring that the affect that is induced is related to (invested in) the measured behavioral indicants of effective functioning.

#### Summary

The purposes of this study were to investigate the simultaneous effects of natural and induced affect upon autonomic and intellectual functioning. Heart rate, skin temperature, and rate of sweat were selected as the measures of autonomic activity. Problems of ingenuity, multiple uses, digit span reversed, and letter association were the tests used to measure intellectual productivity.

Ss were paired into either mutual high preference pairs (natural positive affect) or mutual low preference pairs (natural negative affect) on the basis of sociometric data. There were 8 high preference pairs and 8 low preference pairs. Ss were seen during the experiment in pairs, and were subjected to either positive or negative treatment. Positive treatment consisted of telling the Ss that their psychological reports were going to be read to them during the course of the experiment. They were told that the reports would be pleasing to them because the tests had indicated that they were mature, well integrated people. Fictitious "norms" for the tests of intellectual productivity also were used in implementing positive treatment. This was done by setting low standards of performance on the tests and by praising the Ss for their performance. Negative treatment consisted of suggesting

to the Ss that their psychological reports were "bad" and would deal with highly personal matters such as their phantasy life and sexual adjustment. The "norms" used in this treatment were high and the Ss were told that they were not doing well on the tests.

Hypotheses were restricted to the prediction of main effects for both the autonomic variables and the intellectual measures. Of the autonomic measures, only skin temperature was found to be related to the treatment and preference conditions. The negative treatment was associated with lower skin temperature for the high preference pairs. This relationship was found to vary with order of test presentation and with time (period of experiment). Heart rate was found to be related to order of test presentation and time (period of the experiment).

These results indicated that the preference and treatment conditions were rather weak, relative to methodological "artifacts," i.e., order of test presentation and time within the experimental session. That the effects that were found to be significant during the early part of the experiment tended to decay was seen as further evidence of the weakness of the treatments.

Of the four intellectual tests, problems of ingenuity and multiple uses were found to be sensitive to the preference and treatment conditions. On both tests, the Ss who received negative treatment performed significantly better than those Ss who received positive treatment. This increase in performance under negative treatment was associated with increase in autonomic functioning. If this increase

is considered as a mild departure from characteristic level of activation, the finding of increased arousal together with increased performance can be interpreted as consistent with the part of our hypothesized paradigm dealing with activation and performance. The breakdown occurred in our effort to manipulate or induce logically consistent effects on autonomic activity by means of interpersonal treatment. The treatment that was intended to induce negative affect resulted in a "mild" increase in autonomic functioning and in an increase in intellectual output, features which theoretically should be concomitants of positive affect. The treatment intended to induce positive affect failed, for the most part, to alter either autonomic or intellectual functioning.

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Analysis of Variance for Heart Rate (in Logarithms)  
Considering Preference, Treatment, Order, and Trend

Source	df	Sum of Squares	Mean Square	F	p
Preference	1	2768.89	2768.89	1.88	--
Treatment	1	603.63	603.63	----	--
Order	1	17.48	17.48	----	--
Preference x Treatment	1	4211.53	4211.53	2.86	--
Preference x Order	1	616.61	616.61	----	--
Treatment x Order	1	1651.65	1651.65	1.12	--
Preference x Treatment x Order	1	2773.01	2773.01	1.88	--
Error b (Subjects in same group)	24	35390.60	1474.61		
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Trend	3	2705.90	901.97	12.66	.01
Treatment x Trend	3	381.19	127.06	1.78	--
Order x Trend	3	1250.55	416.85	5.85	.01
Preference x Trend	3	548.92	182.97	2.57	--
Treatment x Order x Trend	3	191.72	63.91	----	--
Preference x Treatment x Trend	3	193.53	64.51	----	--
Preference x Order x Trend	3	301.01	100.34	1.41	--
Preference x Treatment x Order x Trend	3	99.67	33.22	----	--
Error a (Subjects x Trend)	72	5131.47	71.27		
Total	127	58837.36			

## Analysis of Variance for Skin Temperature (in Logarithms)

Considering Preference, Treatment, Order, and Trend

Source	df	Sum of Squares	Mean Square	F	p
Preference	1	5960.95	5960.95	6.77	.05
Treatment	1	2480.72	2480.72	2.82	--
Order	1	2304.35	2304.35	2.62	--
Preference x Treatment	1	319.10	319.10	----	--
Preference x Order	1	2203.66	2203.66	2.50	--
Treatment x Order	1	192.82	192.82	----	--
Preference x Treatment x Order	1	5760.66	5760.66	6.54	.05
Error b (Subjects in same group)	24	21134.19	880.59		
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Trend	3	208.69	69.56	4.00	.05
Treatment x Trend	3	318.08	106.03	6.10	.01
Order x Trend	3	693.15	231.05	13.30	.01
Preference x Trend	3	64.88	21.63	1.25	--
Treatment x Order x Trend	3	1.35	0.45	----	--
Preference x Treatment x Trend	3	95.44	31.81	1.83	--
Preference x Order x Trend	3	208.32	69.44	4.00	.05
Preference x Treatment x Order x Trend	3	79.16	26.39	1.52	--
Error a (Subjects x Trend)	72	1250.37	17.37		
Total	127	43275.89			

Table 3  
 Analysis of Variance for Scores  
 on Problems of Ingenuity

Source	df	Sum of Squares	Mean Squares	F	p
Preference	1	200.00	200.00	----	--
Treatment	1	7800.00	7800.00	7.09	.05
Order	1	-----	-----	----	--
Preference x Treatment	1	7800.00	7800.00	7.09	.05
Treatment x Order	1	100.00	100.00	----	--
Preference x Order	1	-----	-----	----	--
Preference x Treatment x Order	1	4600.00	4600.00	4.18	--
Error	24	26400.00	1100.00		
Total	31	46900.00			

Table 4  
Analysis of Variance for Scores  
on Multiple Uses

Source	df	Sum of Squares	Mean Square	F	p
Preference	1	100.00	100.00	----	--
Treatment	1	13200.00	13200.00	6.99	.05
Order	1	1700.00	1700.00	----	--
Preference x Treatment	1	100.00	100.00	----	--
Treatment x Order	1	100.00	100.00	----	--
Preference x Order	1	100.00	100.00	----	--
Preference x Treatment x Order	1	2100.00	2100.00	1.11	--
Error	24	45300.00	1887.50		
Total	31	62700.00			

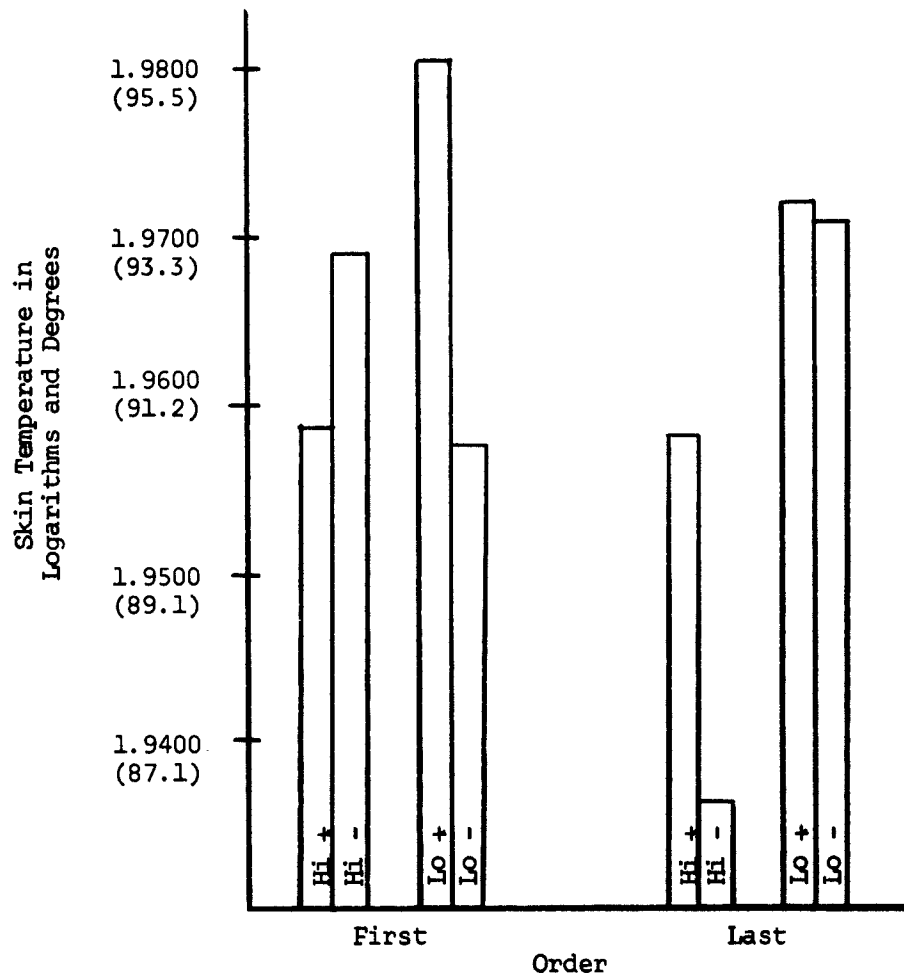


Figure 1. The interaction of preference, treatment, and order on skin temperature. Hi, Lo, +, and - refer to preference and treatment conditions

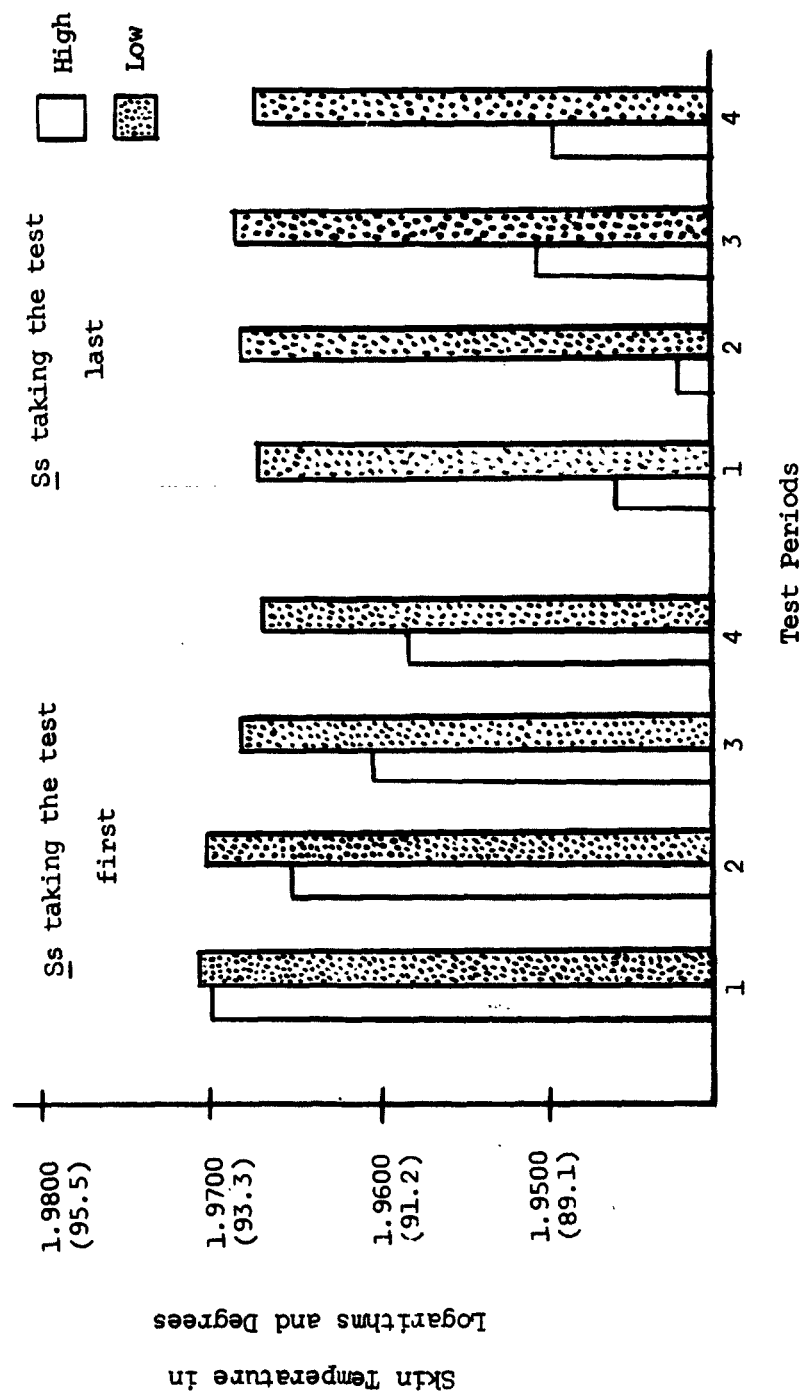


Figure 2. The interaction of preference, order, and trend on skin temperature

Footnotes

1. This paper is based on a dissertation conducted by Mack under Izard's supervision.
2. Now at Florence Darlington Mental Health Center, Florence, South Carolina.